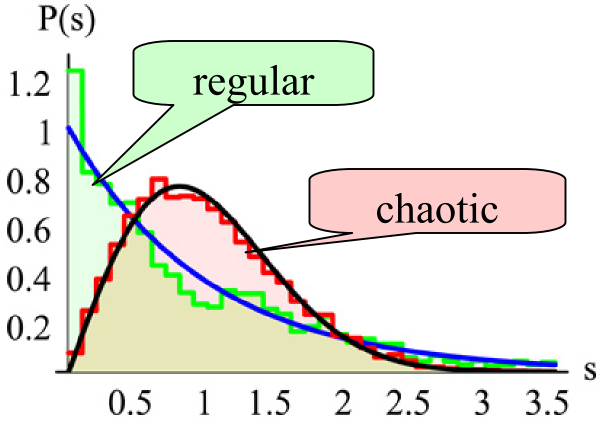
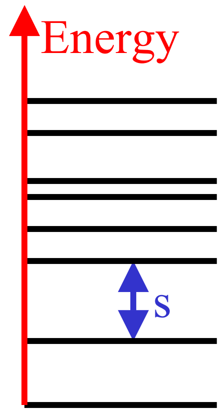
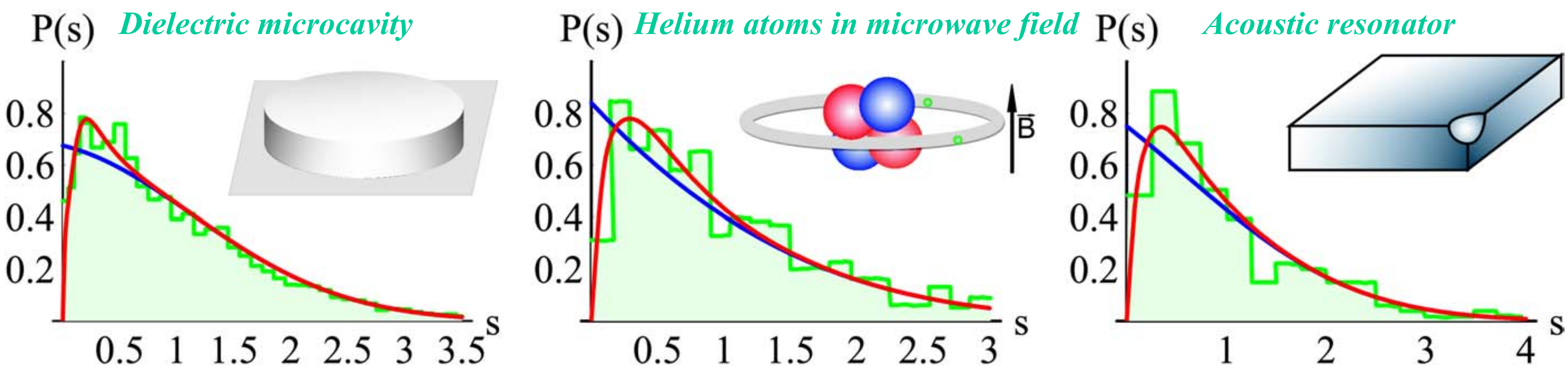
Universal level spacing distribution in quantum systems



Level spacing distribution is a main signature of classical chaos in quantum systems



Majority of real-world systems*: *mixed dynamics (both regular and chaotic trajectories depending on initial conditions)



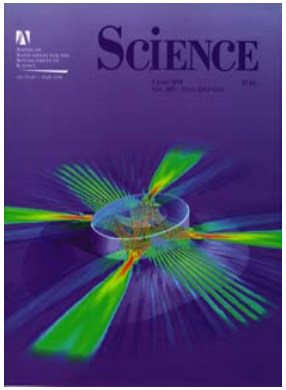
a) b) c)

$$P(s)\propto \rho^2 F\left(\frac{s}{v^2}\right)e^{-\rho s}\,\mathrm{erfc}\left(\frac{\sqrt{\pi}}{2}(1-\rho)s\right)+\left[\frac{\pi}{2}(1-\rho)^2 s+2\rho F\left(\frac{s}{v}\right)\right](1-\rho)e^{-\rho s-\frac{\pi}{4}(1-\rho)^2 s^2}$$, where $F(x)=1-\dfrac{1-\sqrt{\frac{\pi}{2}}\,x}{e^x-x}$

Red: V. Podolskiy and E. Narimanov, submitted to Nature (2003)

Blue: earlier result [M. Berry and M. Robnik, J. of Phys.A (1984)]

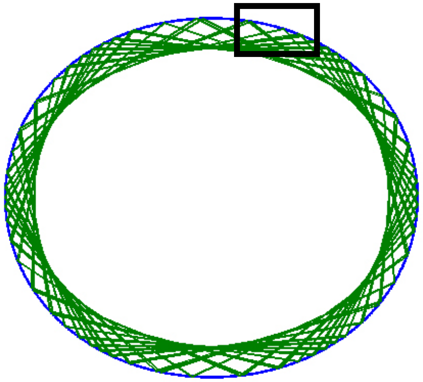
Green: actual data

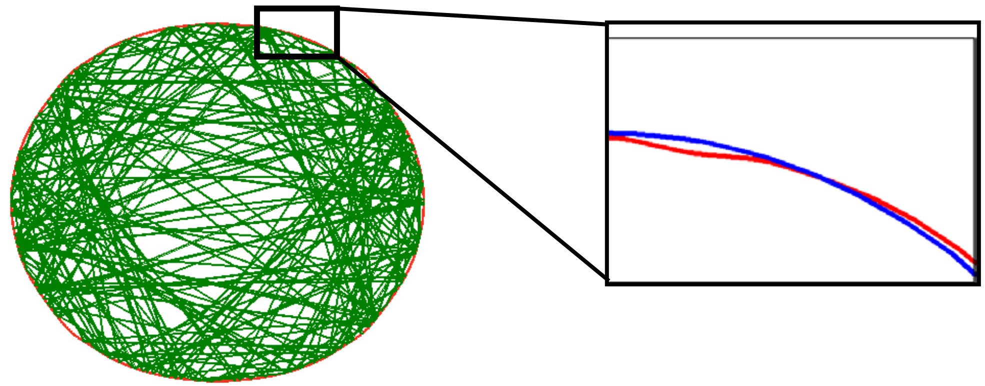


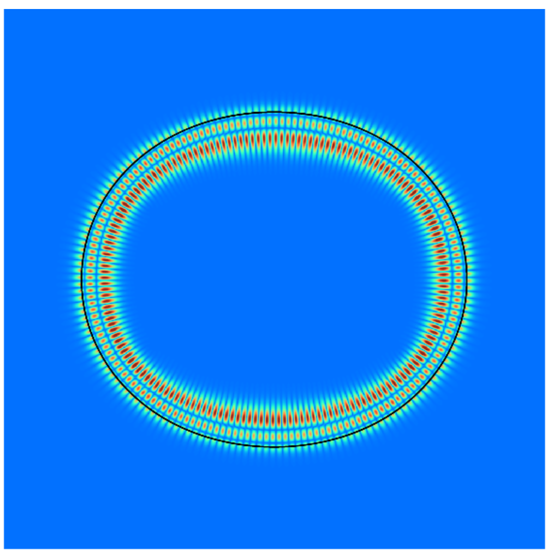
Dynamical localization in microdisk resonators

Microdisk resonators used in novel microlasers, filters, etc. Operate on modes localized on stable classical trajectories

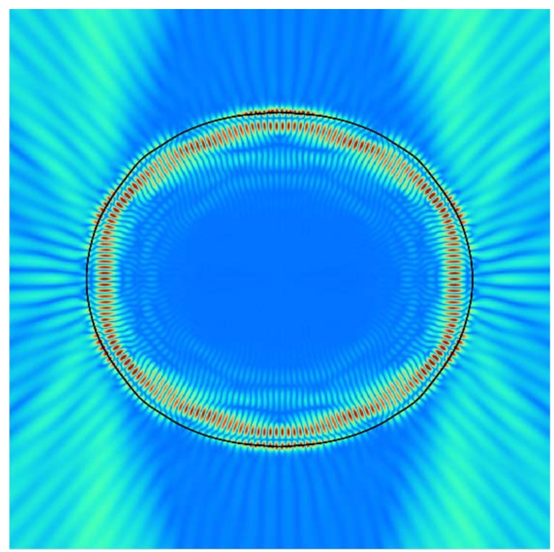
Shape imperfections due to fabrication techniques breakdown the regular trajectory pattern







Desired shape and mode pattern

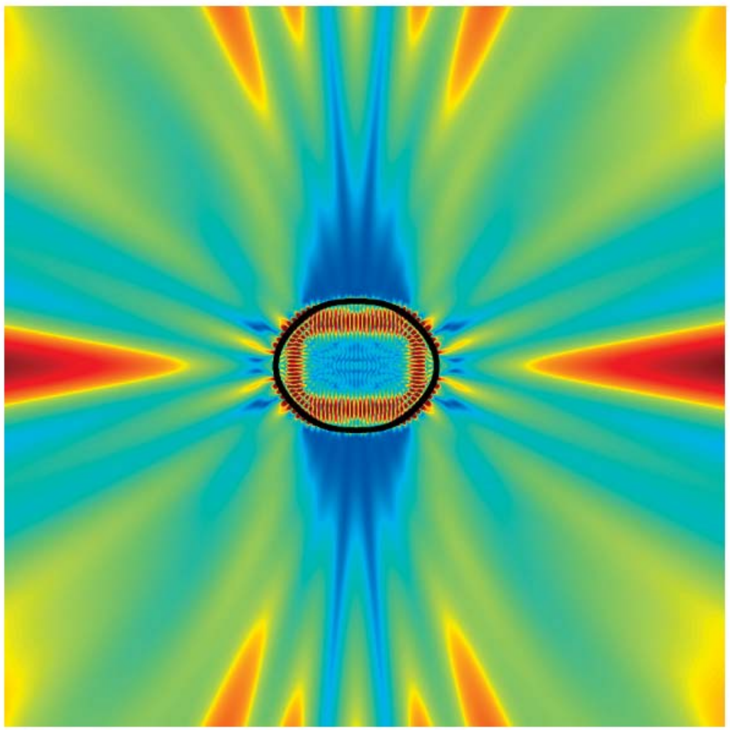


Dynamical localization leads to a suppression of chaos and recovery of quasi-regular mode pattern

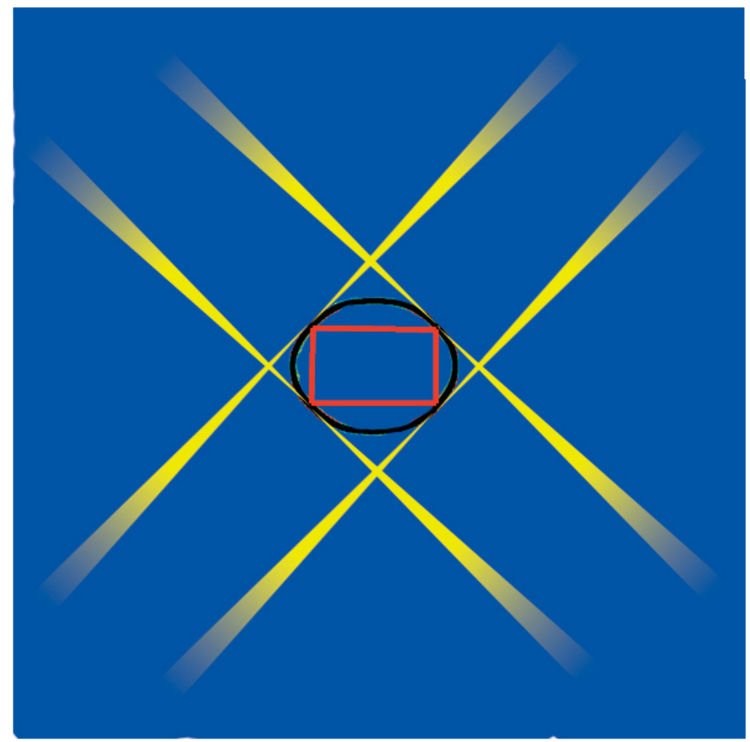
V.A. Podolskiy, E.E. Narimanov, submitted to PRL

Chaos assisted tunneling in dielectric resonators (slide 1)

Even though the mode may be strongly localized on stable classical orbit, its emission directionality can be dramatically different from the expected pattern emission directionalities. The difference is due to phenomenon of chaos-assisted tunneling



Actual emission

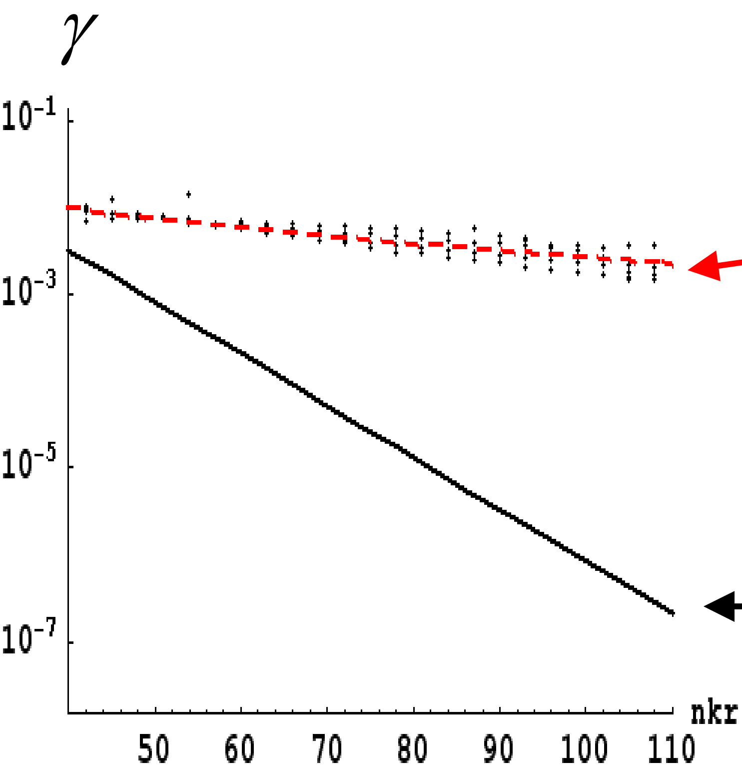


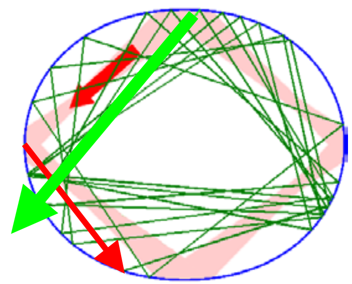
Emission expected from geometrical optics

Red – high intensity; blue – low intensity

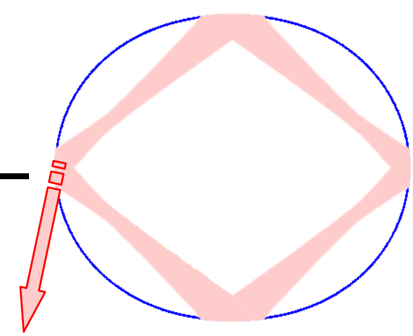
Chaos assisted tunneling (CAT) in dielectric resonators (slide 2)

[Lifetime of regular modes]



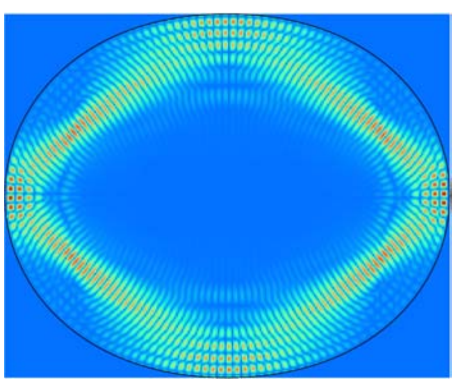


CAT escape - small violation of law of reflection (diffraction) followed by classical propagation until **allowed escape**; Explains results of numerical calculations (dots)



Direct escape due to large violation of total internal reflection (evanescent escape)

$$\langle \gamma \rangle \propto \frac{\Gamma\left(\frac{AkR}{\pi}, 2\frac{AkR}{\pi}\right)}{\Gamma\left(\frac{AkR}{\pi}+1\right)}$$



Actual “diamond” mode

V.A. Podolskiy and E.E. Narimanov, submitted to Optics Letters